Kuiu Island Black Bear Population Estimation Using Biomarking and DNA

Elizabeth Peacock

This is a progress report on continuing research. Information may be refined at a later date.

FEDERAL AID
ANNUAL RESEARCH PERFORMANCE REPORT

PROJECT TITLE: Kuiu Island black bear population estimation using biomarking and DNA

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COOPERATORS: University of Nevada Reno

FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NR.: W-27-5

PROJECT NR.: 17.7

WORK LOCATION: Kuiu Island

STATE: Alaska

PERIOD: 1 July 2001 – 30 June 2002

I. PROGRESS ON PROJECT OBJECTIVES

This document reports on the progress on three main objectives on the Kuiu Island Black Bear Project. Progress on the project during this period took place in the field from June-September 2002. I will not report on the objective regarding effective population size, as no progress was made on this objective during the field season.

OBJECTIVES

I.   Black Bear Population Estimation: Tetracycline Biomarking

II.   Genetic Tagging of Black Bears on Salmon Streams

III. Movement of Black Bears among Islands of the Alexander Archipelago

II. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN THIS PERIOD

OBJECTIVE 1: Black Bear Population Estimation: Tetracycline Biomarking

In 2002, a comprehensive tetracycline biomarking project was implemented to estimate the density of black bears (*Ursus americanus*) on North Kuiu Island. The number of bears with

biomarks serves as the first capture sample in a mark-recapture model, where the hunters' harvest serves as the recapture sample. After the success of the biomarking project in 2000, it was decided that it was necessary to increase the precision of the population estimate. In addition, there may be a negative bias in the 2000 population estimate because both the capture and recapture samples represent a subpopulation of bears that uses only the coast and road system. It was therefore decided to distribute tetracycline baits according to a systematic grid, rather than along the coast and roads to eliminate the potential for bias.

The following factors were considered in the planning effort of the 2002 biomarking project. One option for implementation was to increase the size of the study area for tetracycline biomarking to include the entirety of Kuiu Island. Baiting on the entire island would have allowed us to decrease the density of baits, *i.e.,* decrease the proportion of bears marked, while still keeping confidence intervals narrow due to the increase in sample size. Baiting on the entire island would also allow us to be more confident regarding the assumption of geographic closure. Despite these advantages, we decided rather to increase the baiting intensity on Kuiu, north of Port Camden – Bay of Pillars isthmus. This decision was made because of the logistical obstacles in distributing baits to remote areas in a short period of time. In addition there were legal obstacles, *i.e.,* helicopters in wilderness areas and the financial costs would be enormous. A simulation suggested that if we increased the baiting intensity on just the northern part of the island from 188 baits (number of baits in 2000) to 263 baits (one bait per 2.56 km^2), the width of the resulting confidence intervals, *i.e.,* precision, would be acceptable. Figure 1.

Figure 1. Simulations of number of baits needed in 2002 tetracycline biomarking effort to accomplish acceptable 95% confidence interval widths. This simulation assumes a 60% baiting success. Baiting success was in actuality higher – 72-76%.
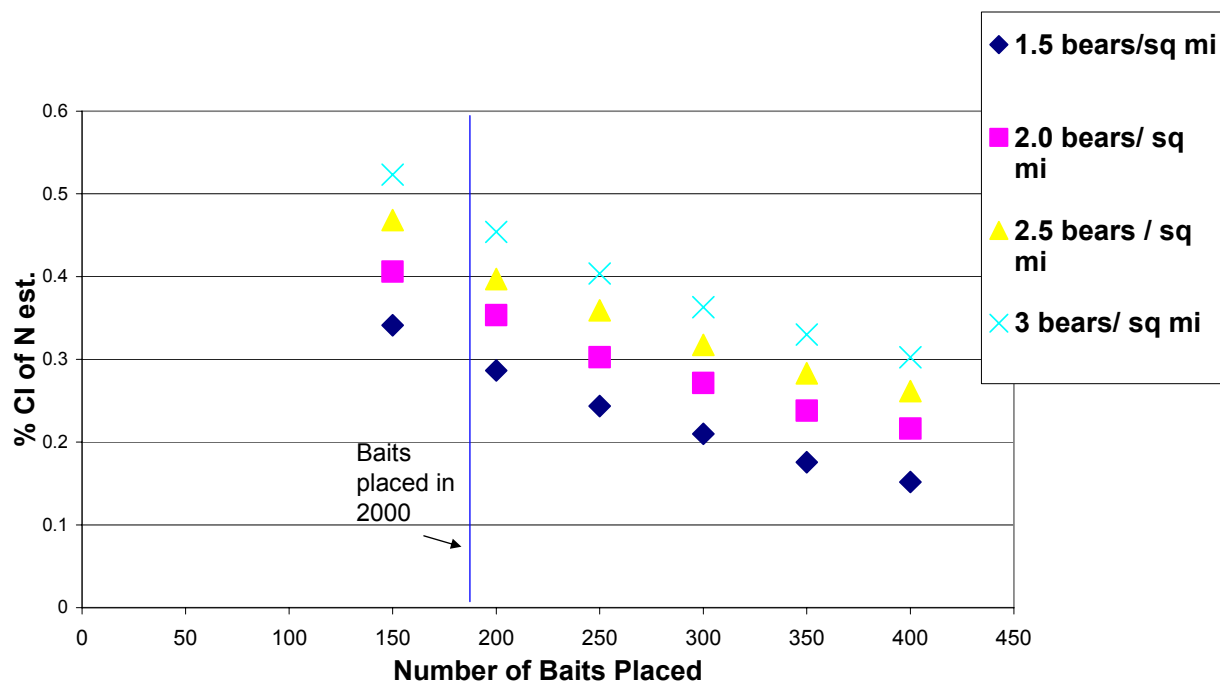
Please refer to earlier reports (2000 & 2001) for specific methodology regarding tetracycline baiting, retrieval, bone sampling and analysis. Here I will only report on differences from the 2000 pilot study, and results specific to the 2002 project.

In June 2002, 263 tetracycline-laced baits were distributed according to a 1.6 x 1.6-km grid on Kuiu Island, north of the Bay of Pillars-Port Camden isthmus. Baits were distributed along the coast and road system, and also in alpine and other less-accessible areas by helicopter. Kayaks were used for less-accessible areas along the coast, and some baits were distributed cross-country by foot. Baits were distributed over four days from June 28th-July 1st by a team of 18 Alaska Department of Fish and Game (ADF&G) employees, United States Forest Service (USFS) employees, and volunteers.

This year, baits were half the size of the 2000 baits; they consisted of only ½ lb. of beef fat and bacon. The brewed scent had fewer fish parts, and was sweeter, consisting of sugar, molasses, fish parts and beef fat. Bait boxes were smaller and measured 22.9 x 10.2 x 7.6 cm (9 x 4 x 3 in) on a 30.5 cm (12 in) *1x4* backboard.

Baits were placed in grid cells such that they had the highest probability of being taken. North Kuiu was divided into 328 grid cells, though many of the coast cells were not complete cells. Some cells were deleted because less than 50% of the cell consisted of land area or that the cell contained no bear habitat, *i.e.,* rock and ice.

Baits were first checked over for days from July 5th - 8th. Baits were left out if they were not taken. This was due to low initial bait visitation; only 53% of the baits had been taken by the first retrieval period. This low bait visitation could be due to (1) difference in scent used (2) lower ambient temperature causing the baits to not to become pungent or (3) a late spring causing a change in habitat use by the bears. Baits were rebaited with meat and molasses. Baits on the coast and the road system were visited again between July 11th and 14th. Baits in the alpine were revisited on August 15th 2002. Figure 2.

Of the total, 72-76% of the baits were taken (*n* = 191-201); this range incorporates ten baits, which may or may not have resulted in a marked bear. At nine of these bait stations, there was no sign that a bear took the bait. However there was no sign that any other animal took the bait. Under the assumption that another smaller animal would be more likely to leave sign, as the box would be more difficult to open, these nine can be considered as baits consumed by bears. At the 10th bait, four tetracycline pills were found. Under the *a priori* decision, this bait should also be considered taken, as greater than half of the pills were missing. Population estimates will be made using the maximum and minimum number of bears marked.

Toe bones will be collected in the 2002 black bear hunting season, and a mark-recapture population estimate will be provided using Lincoln-Petersen estimator with Chapman correction. Table 1 shows simulations using baiting data and possible recapture scenarios.

Figure 2. Cumulative percent of tetracycline baits taken by habitat and retrieval visit.
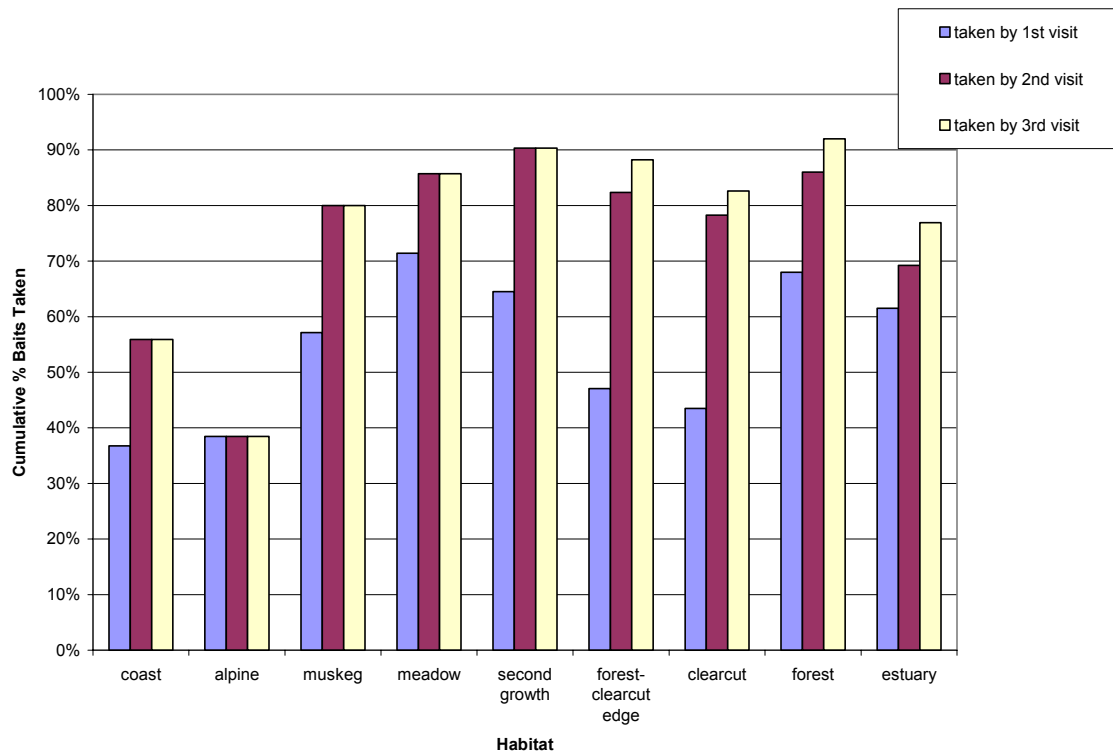
Table 1. Simulated population estimates using a Lincoln-Petersen model and 2002 baiting data. This model uses a projected harvest of 91 bears from North Kuiu Island in the 2002 hunting season and the 2000 estimate of 9.0% double marking.

baits taken	# marked bears	# recaptures	N	95%CI	proportion marked	% CI of N	bears/km^2
201	184.4	4	3410	2618	0.043	76.77	5.06
192	176.1	4	3258	2500	0.043	76.77	4.84
201	184.4	7	2131	1302	0.077	61.10	3.17
192	176.1	7	2036	1242	0.077	61.10	3.02
201	184.4	10	1550	798	0.110	51.48	2.30
192	176.1	10	1480	762	0.110	51.49	2.20
201	184.4	13	1217	546	0.143	44.86	1.81
192	176.1	13	1163	520	0.143	44.71	1.73
201	184.4	16	1002	399	0.176	39.82	1.49
192	176.1	16	957	380	0.176	39.71	1.42
201	184.4	19	852	305	0.209	35.80	1.27
192	176.1	19	814	290	0.209	35.63	1.21
201	184.4	21	774	259	0.231	33.46	1.15
192	176.1	21	740	247	0.231	33.38	1.10
201	184.4	24	681	208	0.264	30.54	1.01
192	176.1	24	651	198	0.264	30.41	0.97
201	184.4	27	608	170	0.297	27.96	0.90
192	176.1	27	581	162	0.297	27.88	0.86
201	184.4	30	549	142	0.330	25.87	0.82
192	176.1	30	525	135	0.330	25.71	0.78

O<small>BJECTIVE</small> 2|: Genetic Tagging on Salmon Streams

During the period July 1 – September 30, 2002, riparian areas of salmon streams on Kuiu Island were sampled for the genetic tagging objective. The intention of this objective is to estimate the number of black bears using each stretch of stream during the course of the salmon-spawning season. Barbed wire fences ($n = 165$) were set up on seven streams to non-invasively collect black bear hair (Woods *et al.* 1999); a total of 283.69 m of barbed wire was set up on bear trails. Average height over the trail was 53.69 cm (±6.05). Samples were taken in weekly intervals to be used in a capture-recapture fashion to estimate the number of bears using each stream. Capture histories will be determined for individual bears as genetic identity of each sample will be determined through microsatellite analysis ten loci in the coming year.

Table 2. Effort data for seven genetic-tagging salmon streams on Kuiu Island.

Creek	Fences	Sampling Intervals	Possible Samples	Samples Taken for Genetic Analysis
Rowan	28	8	683	247 (36%)
Saginaw	28	9	701	217 (31%)
Security	30	12‡	837	306 (34%)
Skinny Rowan†	16	27	163	27 (59%)
Portage	6	8	84	33 (39%)
Cabin	14	8	230	86 (37%)
Kadake	43	10	1250	424 (34%)
Total	**165**		**3945**	**1340 (34%)**

†Skinny Rowan was sampled three times each week. The first sample represented the weekly sample of bear activity. The second sample represented 1 nocturnal period of bear activity; the third sample represented 1 diurnal period of bear activity. Total samples taken from 9 sampling intervals for genetic analysis for nocturnal periods 40; for diurnal period 15.
‡This includes one week where three samples were taken: weekly; nocturnal; diurnal.

Figure 3. Number of possible black bear hair samples collected each week from seven study streams on Kuiu Island.
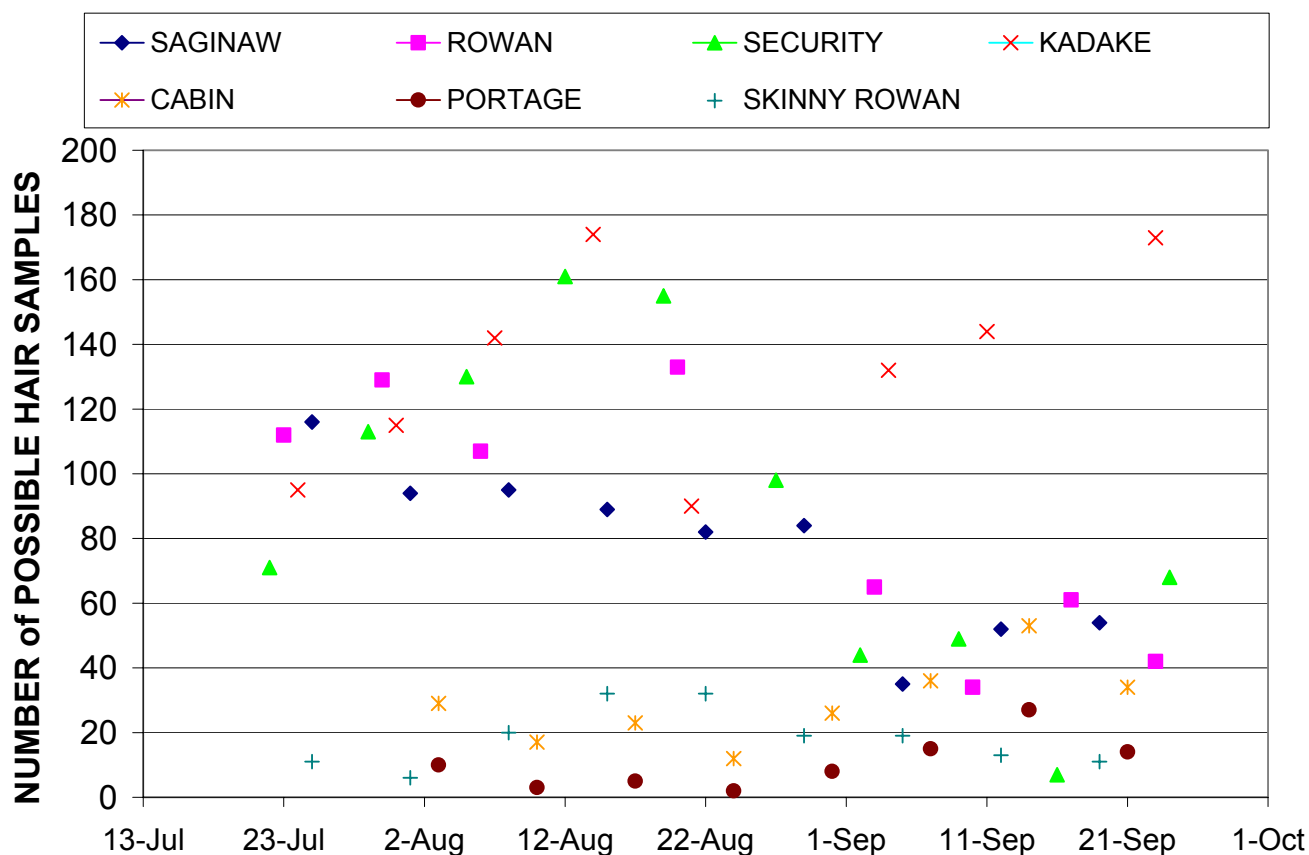
OBJECTIVE 3: Movement of Black Bears among Islands of the Alexander Archipelago

Progress on this objective in this period focused on preparation and presentation of initial results at the 14th International Conference on Bear Research and Management.

Black bears in the study area occur on islands south of Fredrick Sound and on the Southeast Alaska mainland. Initial questions were established to examine black bear movement among islands of the Alexander Archipelago, Southeast Alaska. Tissue samples (n = 327) from harvested bears were collected from Kuiu, Kupreanof, Prince of Wales islands and the Southeast Alaska mainland. DNA was extracted from these tissues and amplified at nine microsatellite loci. Samples were genotyped using an Applied Biosystems Incorporated (ABI) 3700 capillary electrophoresis machine.

Genetic distance was calculated using D_{lr} (Paetkau *et al.* 1997), a metric based on genotype log likelihood ratios. The likelihood that a multilocus genotype is from a certain population is based on that population's distribution of allele frequencies. Allele frequencies at each locus are determined for each population; alleles are expected to pair randomly into genotypes under the assumption of Hardy-Weinberg equilibrium. The probability that an individual genotype at a

particular locus comes from a particular population is calculated with respect to the expected Hardy Weinberg genotype frequencies. These probabilities are then multiplied across all nine loci. The result is the genotype likelihood for that individual being from that population. The same calculation is done for that genotype being from another population, which will have a different allele frequency distribution. The likelihoods of the genotype being from either population are compared. From these comparisons, Paetkau *et al.* (1997) developed the genetic distance metric, D_{lr}. D_{lr} suggests how much more likely a genotype is to occur in the population from which it was sampled, than from another population. Higher D_{lr} values between populations suggest that populations are more genetically distant, or distinct. Table 3 shows preliminary genetic distance results black bear-inhabited islands of the Alexander Archipelago. Figure 4 shows a linear regression where minimum salt water crossing distance between populations explains a significant amount of the variation in genetic distance.

Table 3. Geographic and genetic distances among black bear populations in Southeast Alaska.

Island Pair	Geographic Distance (km)	Salt Water Distance (direct) (km)	Salt Water Distance (via islands) (km)	D_{lr}
Kuiu - Kupreanof	54	0.4	0.4	1.19
Kuiu – Prince of Wales	129	11.6	11.6	9.22
Kuiu - Mainland	140	-	0.5	5.03
Kupreanof – Prince of Wales	137	9.1	9.1	5.07
Kupreanof - Mainland	95	4.6	0.2	2.55
Prince of Wales - Mainland	131	6.3	6.3	6.77

Figure 4. Regression of genetic distance on minimum salt water crossing distance. $r^2 = 0.77$; $p = 0.021$
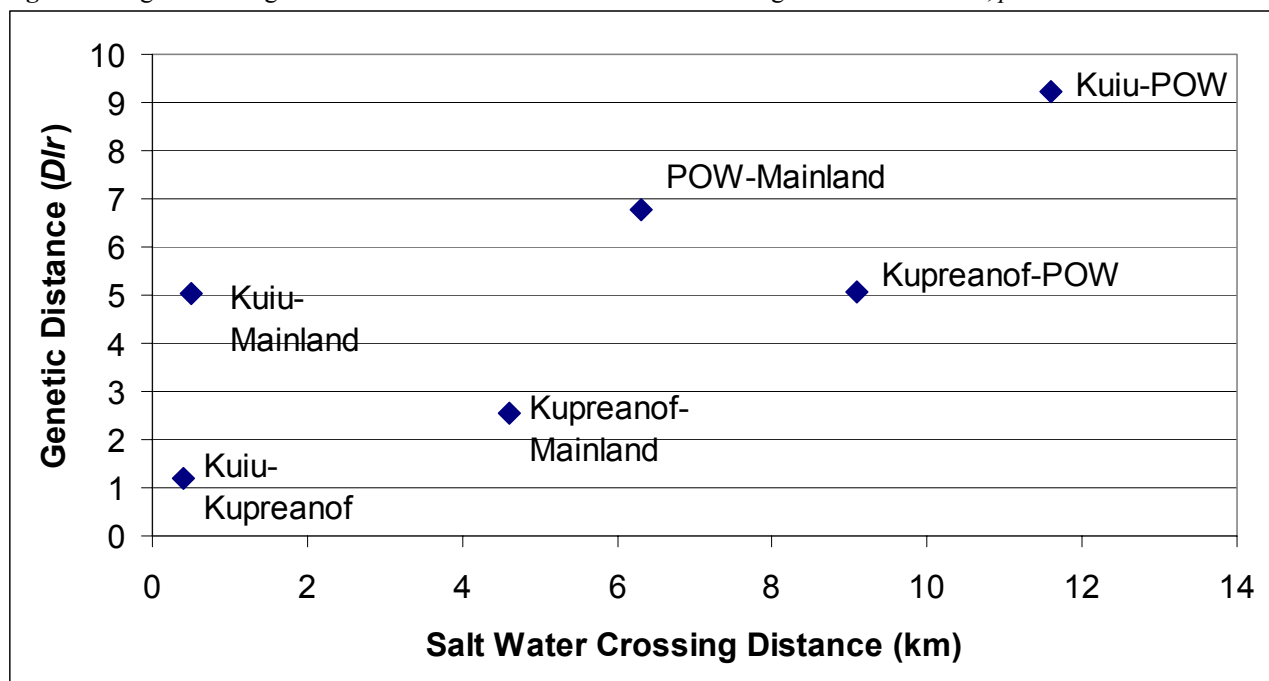
III ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD

None.

IV. PUBLICATIONS

Paetkau, D., L. P. Waits, P. L. Clarkson, L. Craighead, and C. Strobeck. 1997. An empirical evaluation of genetic distance statistics using microsatellite data from bear (Ursidae) populations. Genetics **147**:1943-1957.

Woods, J. G., D. Paetkau, D. Lewis, B. N. McLellan, M. Proctor, and C. Strobeck. 1999. Genetic tagging of free-ranging black and brown bears. Wildlife Society Bulletin **27**:616-627.

V RECOMMENDATIONS FOR THIS PROJECT

None at this time.

VI. APPENDIX

VII. PROJECT COSTS FOR THIS SEGMENT PERIOD

FEDERAL AID SHARE $ 67.8 +   STATE SHARE $ 22.6 = TOTAL $ 90.4

VIII. PREPARED BY: **APPROVED BY:**

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